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Spathodea campanulata Beauv. African tulip tree

Bignoniaceae Bignonia family

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Spathodea campanulata Beauv., commonly called African tulip tree, tulipan Africano, or fountain tree (*16, 25*), has been planted throughout the humid tropics for its large red-orange flowers. The wood of this fast-growing tree is light and little used.

HABITAT

Native Range

The native range of African tulip tree extends along the west coast of Africa from Ghana to Angola and inland across the humid center of the continent to southern Sudan and Uganda (fig. 1) (*12*). The range spans the Equator from 12° N. latitude to 12° S. latitude. Outside the natural range, it has naturalized in at least Colombia (*17*), Costa Rica (*10*), Puerto Rico (*15*), Cuba (*29*), Jamaica (*25*), and Sri Lanka (*30*). The African tulip tree has been successfully planted as an ornamental throughout the humid tropics (fig. 2) (*16, 17*).

Climate

The African tulip tree grows in a wide range of rainfall conditions. If planted, it can survive in areas receiving as little as 1000 mm of mean annual precipitation (MAP). For successful natural reproduction, 1300 mm of MAP or more is required. In Puerto Rico, the most aggressive reproduction and growth is found in areas receiving from 1600 to 2000 mm of MAP. The species grows well in areas with an even distribution of rainfall and in areas with dry seasons of 1 to 3 months, during which it may lose its leaves. The native range of African tulip trees is in an area of Africa with warm, uniform temperatures where the mean temperature of the coldest month is about 27 °C and that of the warmest month about 30 °C. Although it thrives in somewhat cooler environments, it is frost sensitive (*6*).

Soils and Topography

The African tulip tree develops best in fertile, deep, well-drained loams, but the species is not very site demanding. Soil texture may range from loamy sands to clays, pH's may range from 4.5 to 8.0, and soil drainage may vary from somewhat poorly drained to somewhat excessively drained. African tulip trees will even colonize heavily eroded sites. However, form and growth rate suffer considerably on difficult sites. Slope does not appear to be a limiting factor. The species grows from near sea level to 1,200 m (*30*).

Associated Forest Cover

African tulip tree grows naturally in Africa in secondary forests in the high forest zone and in deciduous, transition, and savanna forests (*12*). In Uganda, the African tulip tree and *Albizia* spp., *Caloncoba schweinfurthii* Glig., *Croton* spp., *Dombeya mukole* Sprague, *Olea* sp., *Phyllanthus discoideus* Muell. Arg., and *Sapium ellipticum* Pax. are the first trees to colonize grasslands (*5*). In the Benue region of Nigeria, African tulip trees and such small trees as *Voacanga* spp., *Xylopia parviflora* (A. Rich.) Benth., *Oncoba spinosa* Forsk., *Garcinia ovalifolia* Oliv., *Myrianthus serrastus* (Trecul.) Benth., and *Raphia vinifera* P. Beauv. struggle for existence as opportunists in gaps and among such high forest trees as *Irvingia smithii* Hook.f., *Cola laurifolia* Mast., *Trichilia retusa* Oliv., *Erythrophleum guineense* G. Don, *Chlorophora excelsa* (Welw.) Benth., and *An-*

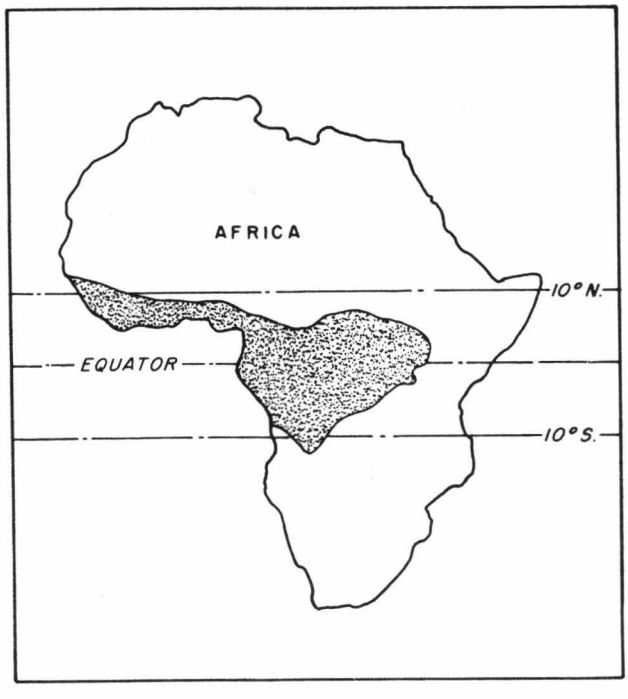

Figure 1.—*Native range of the African tulip tree* (Spathodea campanulata Beauv.).

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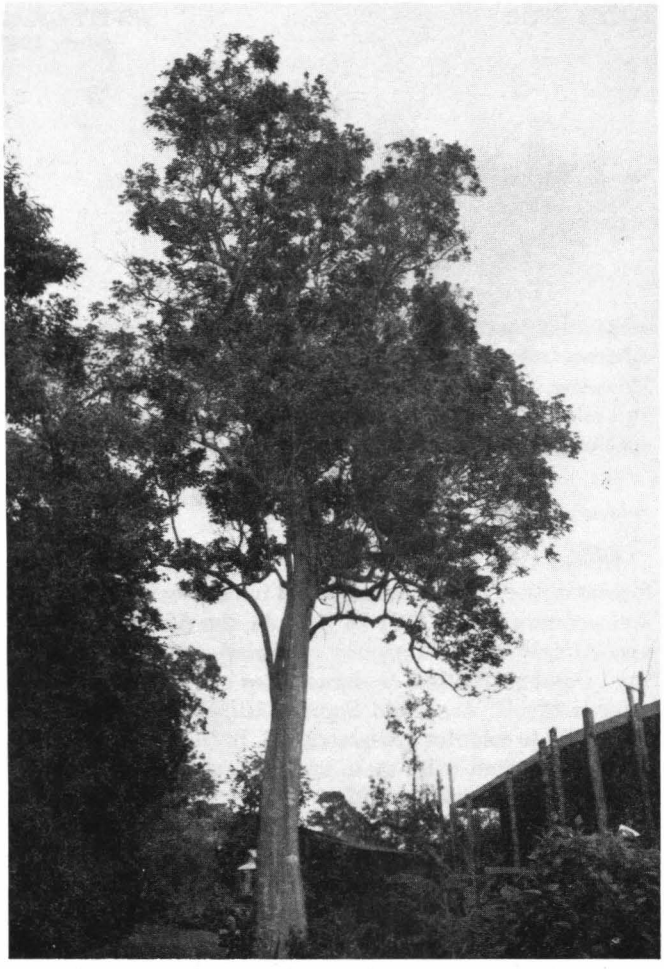

Figure 2.—*A large African tulip tree* (Spathodea campanulata *Beauv.) growing in Puerto Rico.*

thocleista nobilis G. Don (*27*). The African tulip tree grows as an occasional dominant in the extensive stands of *Euphorbia dawei* N.B.Br. found in the Lake Edward Basin of Zaire and Uganda (*28*). The species rarely dominates or occupies a site for more than one generation. Mature stands of African tulip trees in Puerto Rico are frequently invaded by *Guarea guidonia* (L.) Sleumer, a tree that produces valuable timber.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—The flowers are tulip shaped but skewed to one side, a bright red-orange color, about 10 cm long, and clustered in terminal racemes on the branches (*11, 16*). A yellow-flowered variety has been reported on the Gold Coast (*27*). The flowers bloom in such profusion that the trees can be seen from a great distance. Flowering trees observed on certain headlands along the African coast were reportedly used by 18th century navigators (*29*). African tulip trees may begin flowering as young as 3 or 4 years old (*22*). In Puerto Rico, open-grown trees may begin flowering when they are about 5 m tall (author, personal observation). However, in some environments, flowering is delayed until trees are much larger (*29*).

It is unclear when the species flowers in its native range, but in southern Africa, it flowers in fall and winter (*6*), and in the Caribbean, it flowers principally from late winter to early summer (*16, 24*). One to four boat-shaped brown pods, 15 to 25 cm long, usually develop from each flower cluster (*5, 16*).

Seed Production and Dissemination.—Flowering stretches over a 5 or 6 month period, and the pods mature and begin releasing their seeds about 5 months after flowering. In some areas, a few flowers bloom throughout the year (*16*), so seeds are being released almost constantly. The seeds are thin, flat, and surrounded by a filmy wing. The wind often carries them hundreds of meters from their source. Seeds may be collected by harvesting the pods after they turn brown and allowing them to air-dry until they split open. There are about 125,000 seeds per kilogram (*10*).

Seedling Development.—Germination, which is epigeous, may begin in as little as 2 days. The author obtained 38-percent germination from one seedlot spread on the surface of wet soil in a covered tray. The germinating seeds are fragile; they should not be covered with more than a dusting of peat or fine sand and should not be exposed to hard rain. Under 50-percent shade, the seedlings took 2 months to develop the first true leaves. Transplanted at this time, and moved to about 25-percent shade, they required an additional 5 months to reach plantable size (35 cm tall). A regimen with more sunlight probably would have reduced the time required to reach this size. Potted seedlings will probably give the most consistent results. Other methods are untested.

Natural reproduction takes place on bare ground, in grass, and under weeds and brush. Growth appears to be slow until the seedlings develop a few large leaves, after which growth increases. Seedlings sometimes grow from a 3- or 4-cm height to a height of 1 m in 6 months. Several seedlings in Venezuela were reported to have reached 3 m in 14 months (*7*). The only tree measured for height growth in Puerto Rico grew on a hilltop in clay soil. It reached an 8-m height in 3 years and was 12 m tall when 5 years old, after which height growth diminished rapidly.

Vegetative Reproduction.—African tulip trees will coppice up to at least pole size. Vegetative reproduction is easily carried out with cuttings or root suckers (*6*). An investigation of the best types of cuttings for rooting showed that cuttings from mature woody branches 8 to 10 cm in diameter and 60 cm long gave 88- to 91-percent survival of all cuttings vigorous enough to produce sprouts (*1*).

Sapling and Pole Stage to Maturity

Growth and Yield.—The African tulip tree is generally referred to as a medium-sized tree reaching 21 m in height (*20*), but in some parts of West Africa it may reach 30 m in height (*27*). In Puerto Rico, the largest African tulip tree measured by the author was 35 m tall and 1.75 m in diameter at breast height (d.b.h.). The tree was 35 years old according to the property owner. Diameter growth rates of individual trees of up to 5 cm/yr have been noted in Puerto Rico (*10*). Four naturally regenerated stands about 20 to 25 years old on old fields with varying soil types had average dominant-codominant heights of 18 to 26 m and a d.b.h.

Table 1.—*Characteristics of four 20 to 25-year-old* Spathodea campanulata *Beauv. old-field stands in Puerto Rico*

Site*	Soil order	Dominant and codominant trees‡			Stems >0.5 cm Basal area
		D.b.h.†	Height	Density	
		cm	*m*	*Number/ha*	m^2/ha
Vega Baja	Inceptisol	33.7 ± 5.8	18.1 ± 0.7	1,846	51
Guaynabo I	Ultisol	35.4 ± 4.3	21.8 ± 1.5	1,432	41
Guaynabo II	Inceptisol	43.5 ± 2.9	26.5 ± 0.7	2,769	74
Barceloneta	Oxisol	45.8 ± 2.7	21.3 ± 0.3	350§	53

*A 0.314-ha circular plot placed in the center of the stand was used to sample area for all four stands.

†Diameter at breast height.

‡Mean ± standard error.

§This stand had been thinned (small stems removed) and mowed.

range of 34 to 46 cm (table 1). Mean annual stem volume increment in Puerto Rico appears to exceed 20 m^3/ha/yr. It must be recognized, however, that the majority of the trees have defects such as crook or sweep of the stem and fluting of the butt and lower stem. Many trees older than 20 to 25 years that had suffered mechanical or fire damage had butt and heart rots. Growth information for other parts of the world are lacking except for reference to the rapid growth of the species (*17, 22*). If the African tulip tree is to be managed, short rotations to produce fiber or chips would be best. Close spacings of perhaps 2 by 2 m on a rotation of 6 years might be a reasonable starting plan. Once established, the stand could be coppiced for one or more cycles.

Rooting Habit.—Seedlings and saplings develop a large, fleshy taproot, especially in loose soil. The lateral roots develop gradually; old trees may have a massive lateral root system. Older trees develop buttresses and may have fluting of the lower trunk associated with buttressed roots. There is a differing of opinion on the likelihood that African tulip tree roots will damage sidewalks, curbs, and other structures (*16, 22*). Certainly damage is more likely in structures near large, old trees growing on clayey or compacted soil.

Reaction to Competition.—The African tulip tree is shade intolerant; full sunlight is required for rapid growth. Saplings and poles can survive for a number of years under the canopies of early secondary forests. They advance rapidly to the overstory in low-density stands (5 to 10 m^2/ha basal area) and in stand gaps. African tulip tree reproduction is rarely found in African tree stands or under fully stocked stands of midsuccessional species. It is almost always replaced by more shade tolerant secondary species.

The seedlings are very competitive. Disturbed areas near adequate seed sources rapidly fill with dense stands of African tulip tree seedlings. A few of the more advanced and more aggressive individuals quickly assert dominance and remain above potential competitors for life. Seedlings die in vast numbers, but 1,000 to 3,000 stems per hectare may survive for 25 years or more. Basal areas of from 41 to 74 m^2/ha were measured in four nearly pure stands in Puerto Rico (table 1).

Because of its aggressive reproduction, the African tulip tree is frequently a nuisance in pastures, fields with perennial crops, and in vacant city lots. Girdling is an effective means of killing the tree, as is felling with repeated sprout removal. No information is available on chemical control.

Damaging Agents.—In Uganda, the African tulip tree is reportedly attacked by two lepidopterans, two termite species, and one bark beetle (*3*). It was not reported how serious a threat these insects may be. In Puerto Rico, nine insect species in the orders Homoptera, Lepidoptera, Hymenoptera, and Thysanoptera were reported feeding on various parts of the African tulip tree (*18*). Dead trees and limbs in the forest are consumed by the wet-wood termite, *Nasutitermes costalis* (Holmgren) (author, personal observation). African tulip trees are not seriously threated by insects anywhere in Puerto Rico. Seedlings in pastures are browsed by cattle; certainly other domestic and wild herbivores also feed on the foliage.

African tulip trees are quite susceptible to butt and heart rots that enter through wounds and branch stubs. Limbs and trunks of trees near roads and houses pose a danger of unexpectedly breaking and falling (*20*). Trees should be removed as soon as signs of rotten or hollow interiors are noted. The species is suceptible to breakage in high winds (*15*). The African tulip tree is not recommended for urban areas with serious air pollution (*13*). Wood of the African tulip tree rots quickly when in contact with the ground (*18, 24*).

SPECIAL USES

The most important use of the African tulip tree is as an ornamental. It is one of the most beautiful flowering trees in Africa (*4, 20*). Although the likelihood of breakage and a shorter life than many ornamental tree species imposes some restrictions (*17*), the African tulip tree is recommended as a shade tree for parks and yards (*2, 22*). It has been used for coffee shade (*14*), but is inferior to a number of other trees used for this purpose. The species, either planted or growing naturally, is frequently used for living

fenceposts. The African tulip tree helps rehabilitate disturbed lands through its quick invasion and rapid growth.

The wood of the African tulip tree is creamy white to tan, turning tan or light brown upon drying. There is little difference between the sapwood and heartwood. The texture is somewhat coarse with a pleasing grain. The wood is soft and light weight, with a specific gravity (ovendry) of 0.30 to 0.45 g/cm^3 in Gabon (*19*), 0.24 to 0.27 gm/cm^3 in the Philippines (*8, 26*), and 0.26 gm/cm^3 in Puerto Rico. It saws, planes, and drills fairly easily (*19*). This wood has not been used a great deal in the past, but it is suitable for such uses as rough carpentry, crates, dunnage, and cement forms. The fiber dimensions of the African tulip tree have been tested and found favorable for the production of pulp (comparable to *Swietenia macrophylla* King and *Nauclea horsefieldii* (Mig.) Comb. Dox. (*1, 8, 26*). However, high amounts of bleaching agents are required to bring it to acceptable whiteness (*21*). There is no obvious reason why the species could not be used for particle and other composite boards. African tulip tree wood is a notoriously poor firewood (*2*). In fact, a natural resistance to burning has led to its use for bellows and in construction around forges in Africa (*2*).

The seeds are reportedly used as food in Africa (*27*). Various parts of the plant are employed in African folk medicine (*12*) and magic (*24*). The hard central portion of the fruit is reportedly used to obtain a poison used to kill animals (*12*). Tissues of the tree are known to contain saponins (*23*).

GENETICS

Considerable genetic variation probably exists in the African tulip tree across the natural range, as evidenced by differences in tree size and flower color (*27*). There are two species of *Spathodea*. The second species, *S. nilotica* Seem., the Uganda flame tree, is an east African tree of somewhat smaller stature. It may prove to be simply a variety of the African tulip tree (*2*). The diploid chromosome numbers of the African tulip tree are 26, 36, and 38 (*9*).

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